Initial Estimates of External PCB loads

Potomac PCB TMDL
Technical Advisory Committee Meeting
MWCOG
October 31, 2006

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Interstate Commission on the
Potomac River Basin

- **WARNING! These are preliminary estimates of external loads intended to provide an initial assessment of external PCB loads.**

a) Additional sample data are expected.

b) Analysis of the sample data is continuing.

c) CBP Watershed Model continues to be refined.

d) Continuing to test alternative load estimation methods.

Thus, these load estimates may change, perhaps by a factor of 2-5 times, when the draft loading document is completed.

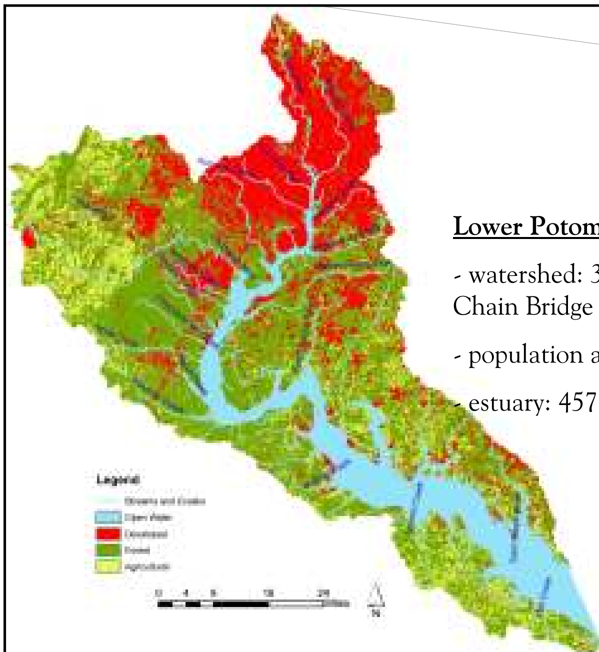
Three topics in this presentation

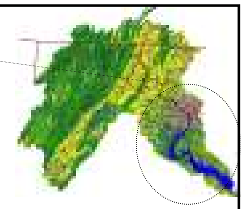
1) A quick review of the Potomac PCB TMDL project.

2) Initial estimates of PCB loads
   a) Methods
   b) Loads from source categories
   c) Loads to specific areas of the estuary.

3) Discuss implications and identify key issues for further investigation

Part 1: Potomac TMDL Review



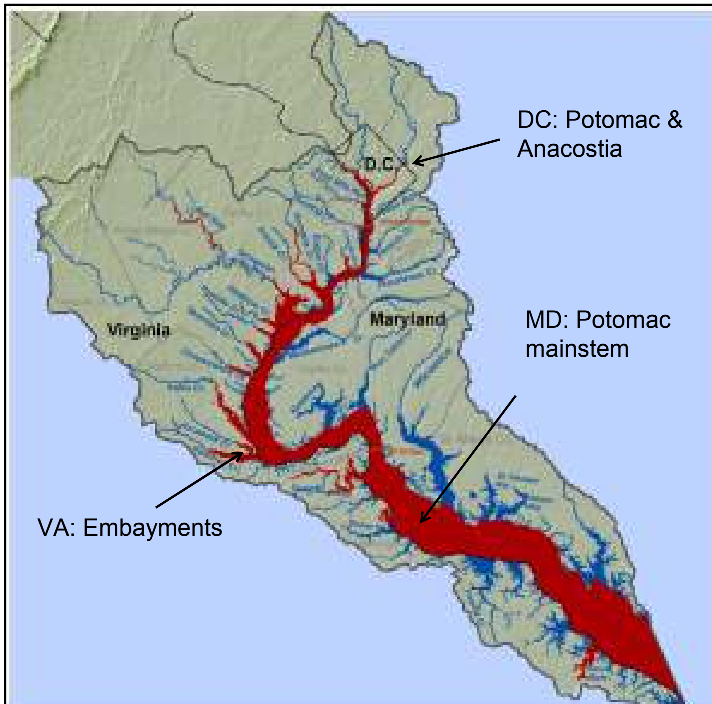


Lower Potomac Watershed

- watershed: 3,120 mi^2, plus 11,560 mi^2 above Chain Bridge

- population about 3.5 million

- estuary: 457 mi^2 ,117 miles long



- Potomac Estuary is on 303(d) impaired waters list because of high PCBs in three jurisdictions.
- One TMDL, done cooperatively, due to EPA 9/2007.

State impairment criteria define the TMDL Targets.

Both Fish Tissue Thresholds and WQ Standards apply.

	Fish Tissue Impairment Threshold (ppb)	Water Quality Standards (ng/l)
Dist. of Col.	20	0.064
Maryland	88	0.64
Virginia	54	1.70
	* Specific reason for 303(d) listing.	

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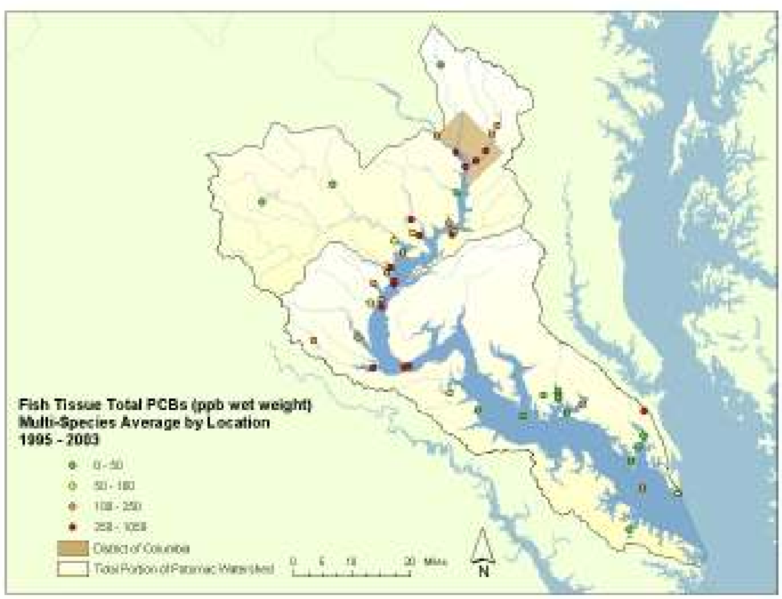
Historical data: PCBs in Fish Tissue



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TMDL Development Schedule

• Compile historical data	2005
• Select modeling framework	2005
• New PCB samples in water, sediment, & WWTPs	2005-2006
• 1st Technical Advisory Committee Meeting	Sep 2005
• Hydrodynamic / Salinity Model completed	Feb 2006
• 1st Round Public Stakeholder Meetings	Jun 2006
• Interim version of PCB model	Dec 31, 2006
• Draft loading summary document	Dec 31, 2006
• Final validated PCB model	Feb 23, 2007
• Draft PCB TMDL to states for internal review	May 1, 2007
• Final draft TMDL report for public review	Jun 15, 2007
• DC, VA & MD Public Meetings & Comment Period	Jun 15–Aug 1, '07
• TMDL Report Submitted to EPA	Sep 1, 2007
• EPA approval of TMDL	Sep 30, 2007

Additional information about this TMDL,

including documents and copies of presentations from previous meetings, can be found at

http://potomacriver.org/water_quality/pcbtmdl.htm

2. Methods for estimating external PCB loads and initial allocation of loads.

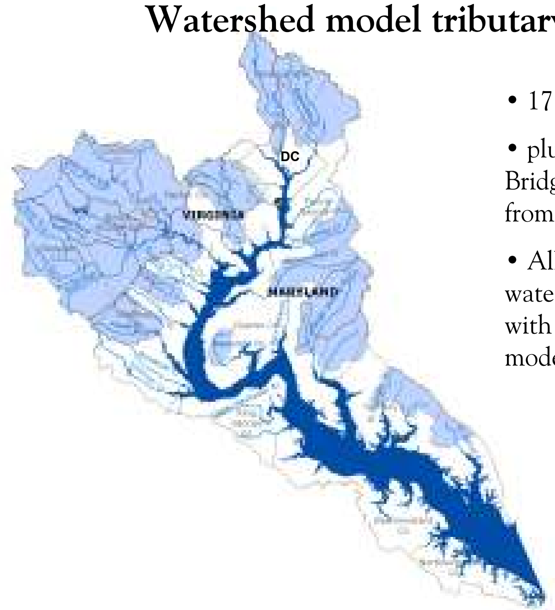
PCB External Source Categories

1) Tributary input
   a) Potomac River
   b) Other tributaries
2) Direct Drainage (Non Point Source)
3) Contaminated Sites
4) Atmospheric deposition
5) Point Sources
6) Combined Sewer Overflows (CSO)

Potomac River, Tributary and Direct Drainage PCB loads

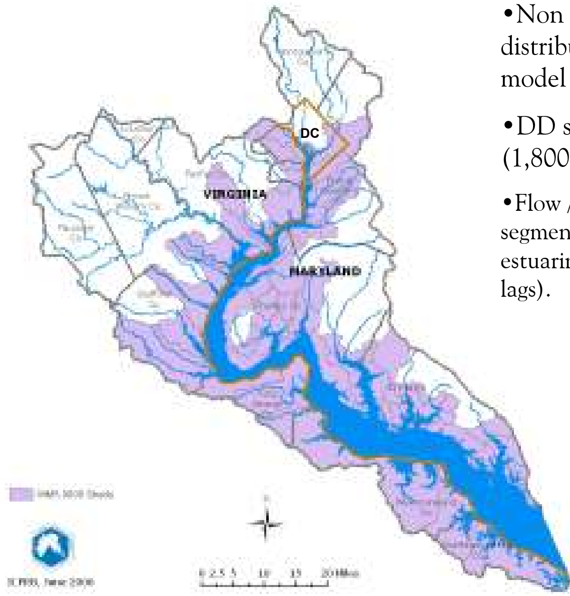
- **Challenge:** How to generate daily flows and loads of PCBs and other parameters as inputs to a tidal PCB model when we don't have stream gages on all tributaries and limited sample data for PCBs and other parameters?
- **Method:**
  - Use Ches. Bay Program Watershed Model (WM5) to generate daily flows, TSS, and carbon from each tributary to an estuarine cell and from direct drainage areas to adjacent estuarine cells.
  - Using PCB data sets from 2000-2006, explored relationships with carbon, TSS, flow, and region. PCB was found to vary with TSS and by geographic region.
  - Estimate daily PCB load for each tributary and direct drainage based on those relationships.
- Advantages of using WM5: Model already built; has undergone extensive peer review; significant support from EPA.
- Disadvantages: we are constrained to period of time that WM5 calibrated for, to the quality of its calibrations, to its parameters, and to its description of the watershed.

Watershed model tributary segments



- 17 tributaries represented,
- plus the Potomac River at Chain Bridge which contributes flow and load from the entire non-tidal watershed.
- All PS & NPS flow and load in watershed delivered to a stream reach with direct link to a single estuarine model cell.

Watershed model Direct Drainage segments



- Non point source flow / load distributed among adjacent estuarine model cells.
- DD segments comprise about 58% (1,800 mi^2) of total watershed area.
- Flow / load from any point source in a DD segment is delivered directly to its adjacent estuarine model cell (no decay or time lags).

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DC CSO area

- All flow presumed to go to CSO pipes.
- CSO pipes are treated as point sources, i.e. connected directly to estuarine model cells.
- Alexandria also has 4 CSO pipes, but there is not a corresponding CSO segment in the WM5.

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Watershed model segments plus estuarine model cells

• Estuarine PCB model segmentation roughly follows Bay Program model segmentation, but more detailed in the Anacostia and less detailed in the lower Potomac.

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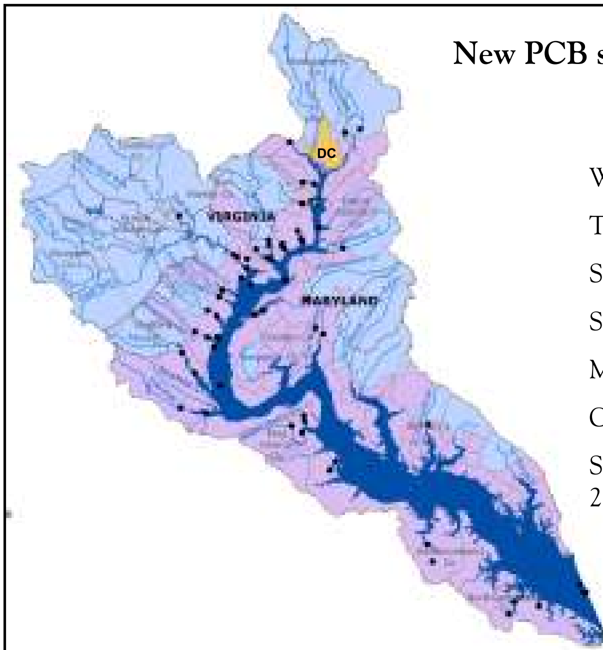
New PCB samples collected 2005-06



	#Sites
WWTPs	15
Tributary	26
Sediment	17
SPMD	16
Mainstem	8
Chain Bridge	1

Supplemented with data collected 2000-2006.

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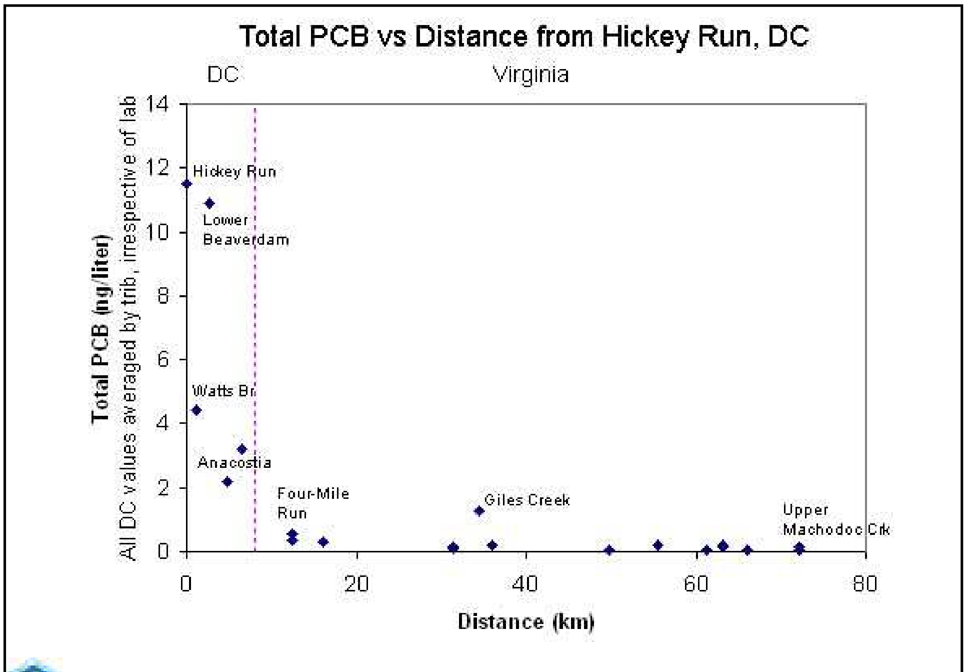

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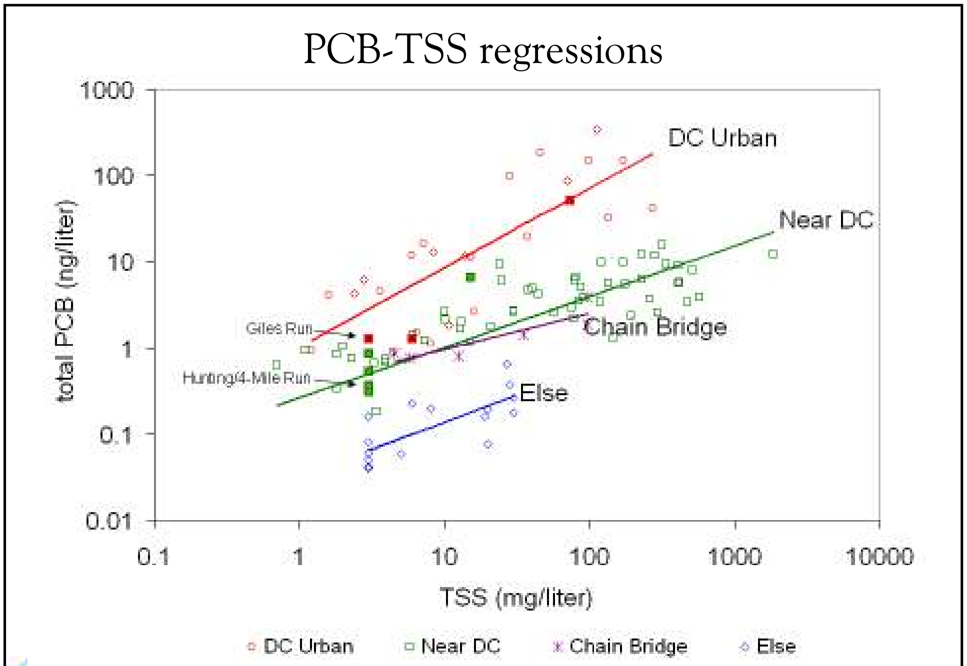

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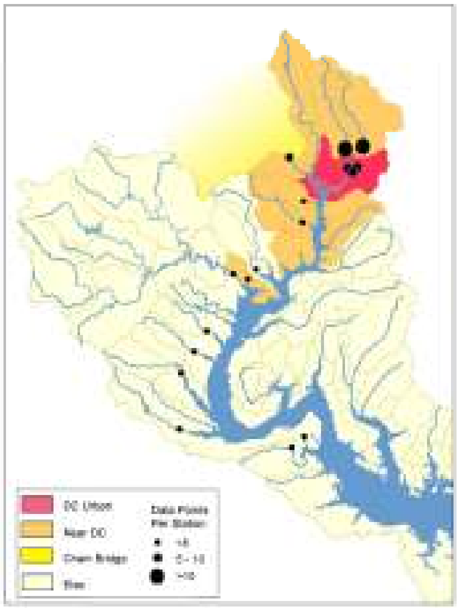


PCB:TSS Zones

PCB (ng/l) = a * TSS ^ b (mg/l)

Region	a	b	r^2
DC Urban	1.0264	0.9207	0.63
Near DC	0.2639	0.5876	0.51
Chain Br	0.3703	0.4149	0.78
Else	0.0324	0.6266	0.57

Note: More samples have been collected, including in MD, and regressions will be recalculated when lab results are available.

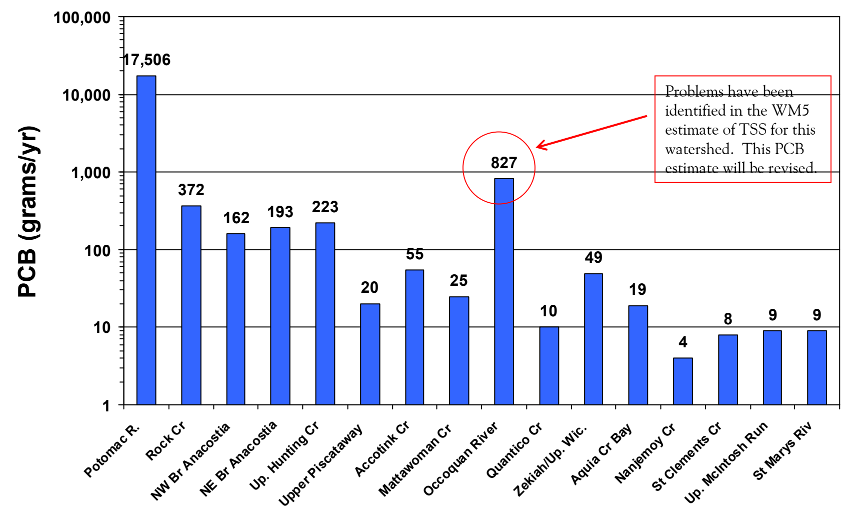
Potomac River, Tributary and Direct Drainage PCB loads

- **Results:** Annual total PCB loads, grams/year

Watershed	Avg	Min	Max
Potomac R. @ Chain Br. (1994-04)	17,500	6,200	43,000
∑Other Tribs (1994-04)	2,000	710	4,600
∑ All Dir. Drain area (1994-99)	1,556	867	2,670

- Annual load is highly dependent on annual flow. Max year is roughly 2.5x average year. Min year is roughly 1/3 average year.
- Direct Drainage, comprising 58% of watershed, and ∑Other Tribs, comprising 42% of watershed, are roughly comparable.

1994-2004 Avg Annual PCB by Tributary



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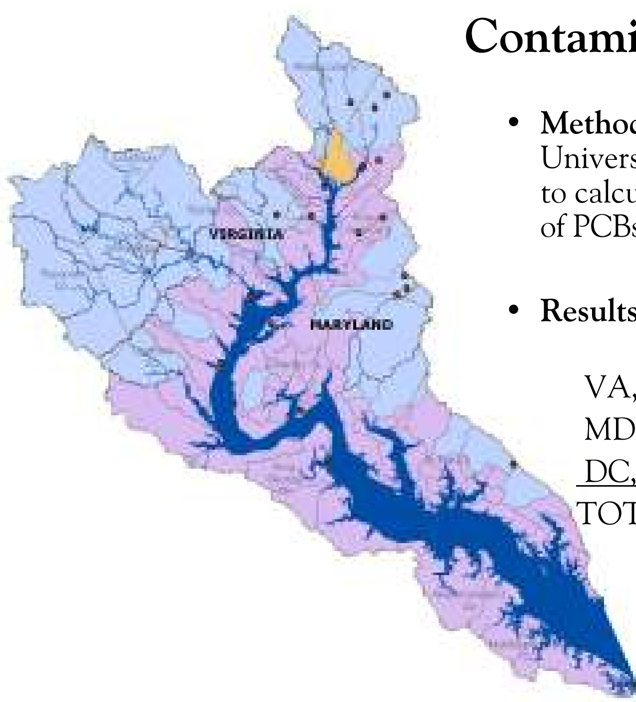

Contaminated Sites

- **Method:** Use Revised Universal Soil Loss Equation to calculate an annual load of PCBs in surface runoff.

- **Results:**

	PCB, g/yr
VA, 6 sites	10
MD, 12 sites	7.2
DC, 2 sites	3
TOTAL	20.2 g/yr

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Contaminated Sites

Dist of Columbia
- Kenilworth Landfill (S)
- Kenilworth Landfill (N)

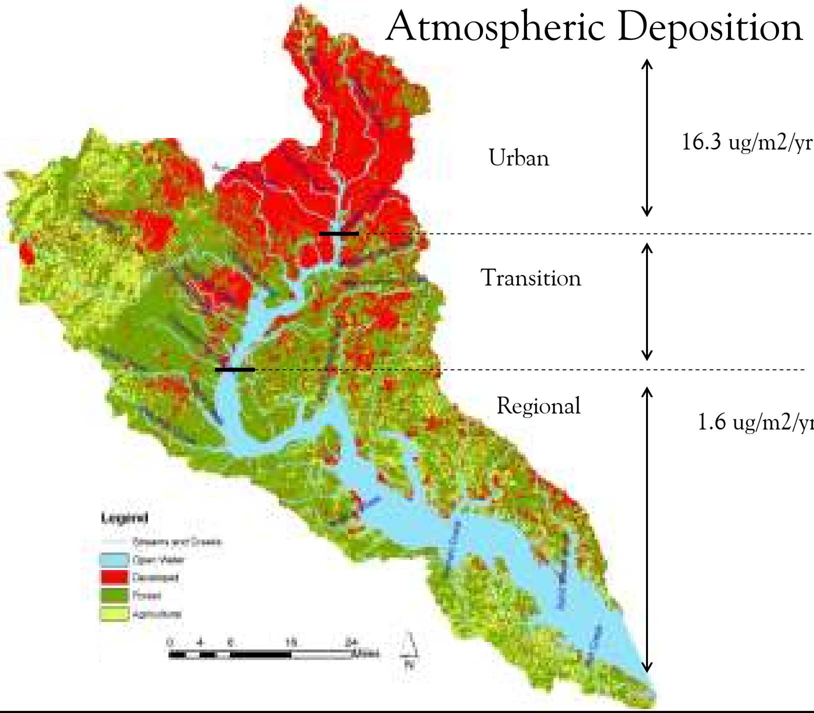
Virginia
- Woodbridge-1+2
- Atlantic
- Davis
- CSX
- Quantico
- Dahlgren-17+19

Maryland
- United Rig. & Haul.
- Rogers Electric
- Waldorf (Nike)
- Andrews AFB
- White Oak
- Beltsville Ag Res Ctr
- Brandywine Receiver Stn
- Brandywine DRMO
- St. Mary's Salvage
- Blossom Point Prov Grnd
- Indian Head
- PEPCO Substations

Atmospheric Deposition

- No Potomac specific samples! Literature review suggests net deposition higher near urban centers. The Ches. Bay Atmospheric Deposition study (1999), estimated:
  - Urban net deposition rate = 16.3 ug/m2/yr tPCB
  - Regional (non urban) rate = 1.6 ug/m2/yr tPCB
- **Method:** Divide Potomac estuary into 3 zones: urban, Regional, and Transition. Assign Urban and Regional zones rates as above. Transition zone rates are linearly interpolated.
- **Results:** With Urban boundary at Hunting Creek and Regional boundary at Chopawamsic Creek, preliminary estimate of annual atmospheric deposition to Potomac estuary: 3.13 kg/yr tPCB .

Atmospheric Deposition Zones



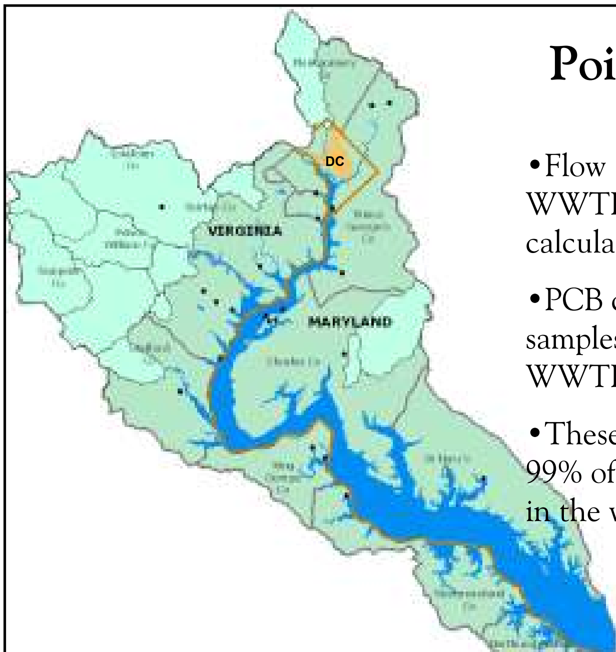
Point Sources

- **Method:**
  - Load calculations for 22 WWTPs (>99% of total point source flow)
  - 1-3 PCB samples at 15 WWTPs. Median of all samples assigned to the 7 unsampled WWTPs.
  - Multiply mean [PCB] at each WWTP * monthly mean flow
  - 2004 annual mean flow used for exploratory purposes.

- **Results:** Blue Plains is by far the largest WWTP by flow so its [PCB] is the major component of total WWTP loading.
  - Mean of three samples collected at Blue Plains = 1.77 ng/l PCB.
  - 2004 Blue Plains annual flow of 334 mgd * 1.77 ng/l = 816 g/yr tPCB.

WWTP annual loads	**PCB**
Blue Plains	816 gr/yr
All other WWTP	115 gr/yr
TOTAL (2004)	931 gr/yr

Point sources



- Flow & loads from 22 WWTPs included in load calculations.
- PCB concentrations based on samples collected at 15 WWTPs.
- These 22 comprise more than 99% of flow from all WWTPs in the watershed.

Point sources

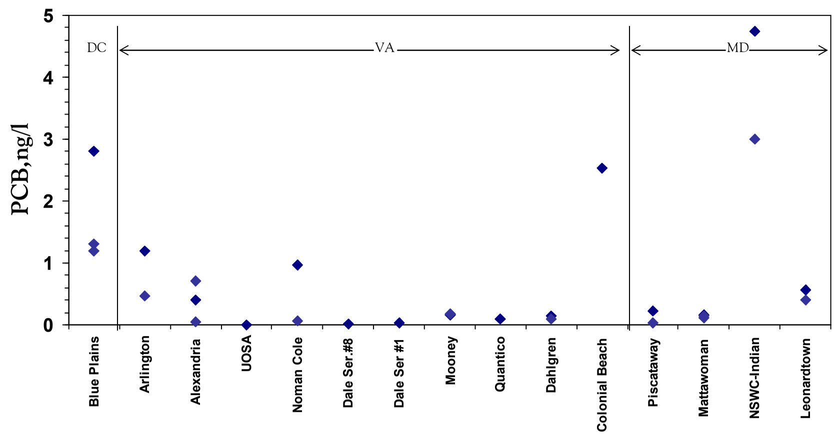
Dist of Col	MGD
Blue Plains	334.24

Maryland	MGD
Beltsville USDA East	0.20
Beltsville USDA West	0.09
NSWC-Indian Head (2Pipes)	0.21
NSWC-Indian Head	0.42
Indian Head	0.25
La Plata	1.17
Piscataway	22.08
Mattawoman	8.12
Leonardtown	0.41

Virginia	MGD
Arlington	28.39
Alexandria	37.42
UOSA	27.20
Noman M. Cole Jr.	41.89
Dale City #8	3.00
Dale City #1	3.08
H.L. Mooney	12.38
Quantico-Mainside	1.09
Aquia	4.39
NSWC-Dahlgren	0.32
Dahlgren Sanitary District	0.21
Colonial Beach	0.89

* Calendar 2004 flows

WWTP PCB Sample Results



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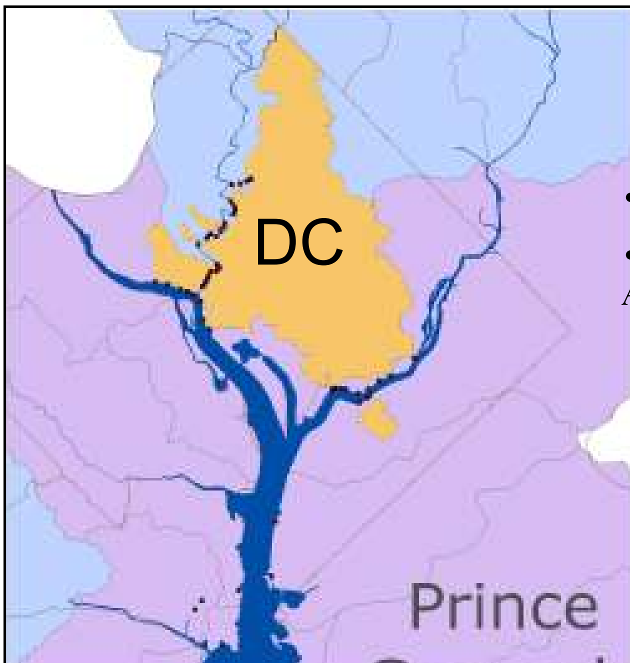
Combined Sewer Overflow Pipes



- 56 CSO outfalls in DC.
- 4 CSO outfalls in Alexandria.

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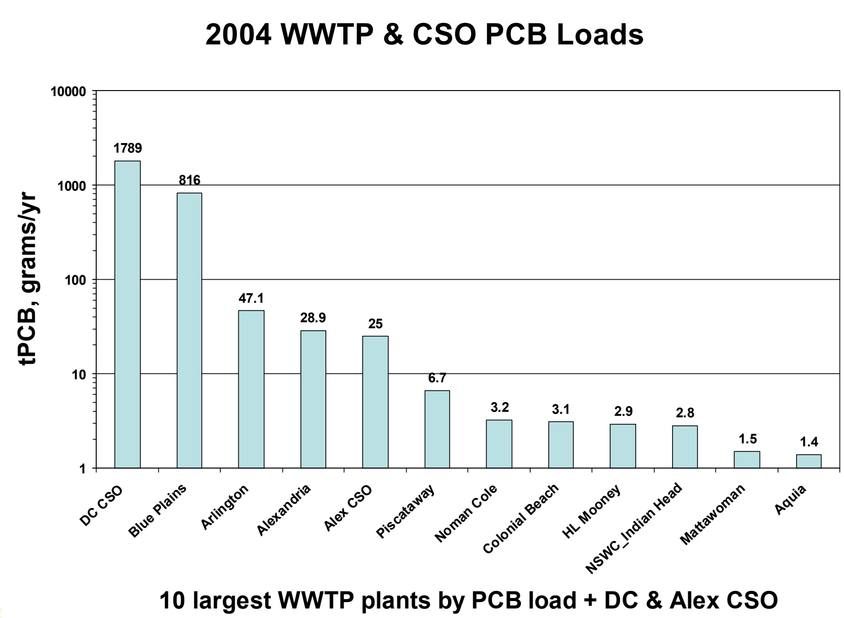
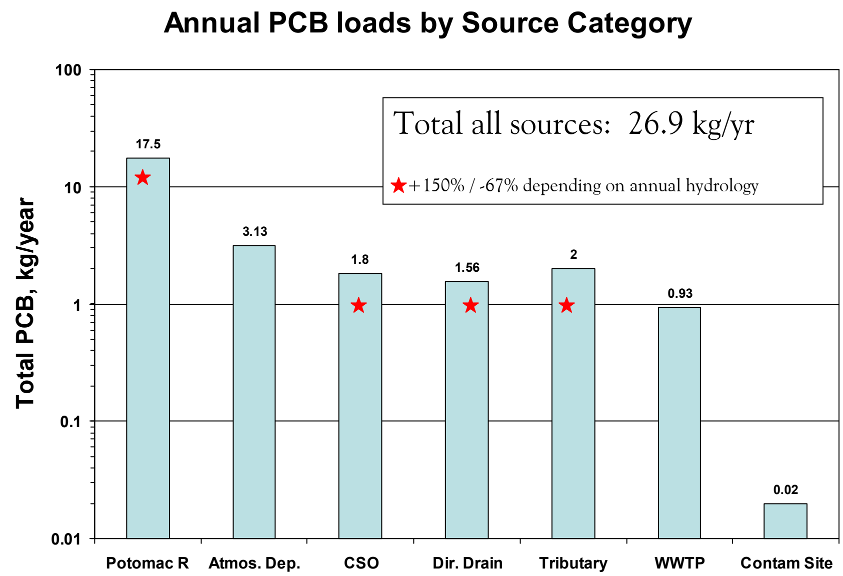
Combined Sewer Overflows

- **Method:**
  - We currently have no PCB samples from CSOs.
  - Apply "DC Urban" regression, [PCB] =1.026 * [TSS] ^ 0.9207.
  - Daily flows obtained from LTI CSO model for calendar 2004 and summed to an annual volume for all DC CSOs and all Alex. CSOs.
  - DC TSS is EMC from all samples collected for LTCP study in 2004.
  - Alex. TSS is median of all samples collected in study in 2002-03.
  - **Other methods for estimating PCBs in CSO are being investigated.**
  - Compare CSO tPCB concentrations below with WWTP concentrations on slide 31.

- **Results:**

	vol. water MG/yr	TSS mg/l	tPCB ng/l	tPCB g/yr
– DC :	4,417	156	107	1,789
– Alex:	165	53	40	25





Reality checks

- **Tributary Loads**
  - G. Foster, GMU, 1992 data, Potomac Chain Bridge: 40 kg/year, about 2x current estimate.
  - G. Foster, 1995 data, Anacostia (NE+NW): 3 kg/year, about 5x current estimate.
  - DC Anacostia PCB TMDL (2003), 1988-90 simulation: 4 kg/year NE+NW Ana, about 7x current estimate.
  - Delaware estuary PCB TMDL. Compare Potomac @ Chain Bridge to Delaware major trib inputs.
    - Potomac @ Chain Bridge: 1.6 g/mi^2/year (1994-1999 mean)
    - Delaware / Trenton: 2.0 g/mi^2/year (model calibration year)
    - Delaware / Schuylkill: 5.3 g/mi^2/year

Reality checks

- **Atmospheric deposition**
  - Potomac: 1.6 – 16.3 ug/m^2/year
  - Delaware: 1.3-17.5 ug/m^2/year
  - When Potomac trib PCB loads are expressed as an annual yield, the range is 2 (urban) to 0.1 (southern) ug/m^2/year, i.e. about 10% of atmos. deposition.
  - DC Anacostia PCB TMDL (2003), using CBP study, estimated 15 ug/m^2/year, about the same as current estimate.

- **Combined Sewer Overflow**
  - DC Anacostia PCB TMDL (2003), 1988-90 simulation: 4.1 kg/year NE+NW Ana, about 2.3x current estimate.

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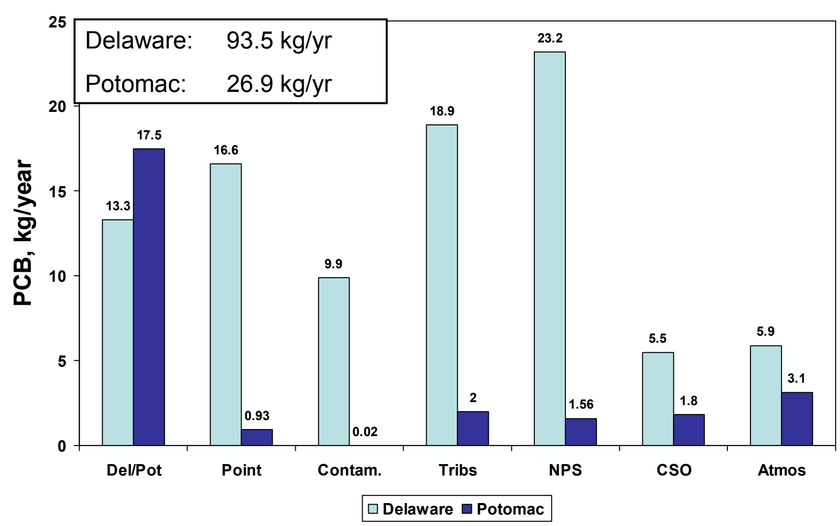
Compare Delaware & Potomac Loads



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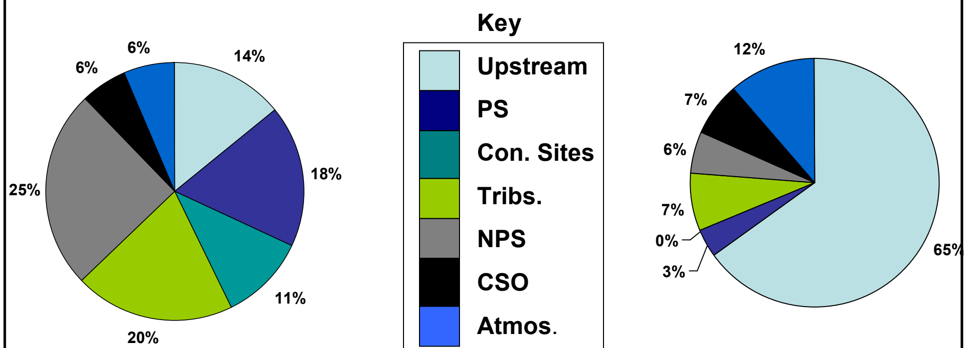
Compare PCB external loadings: Potomac vs Delaware



Delaware Estuary: 93.5 kg/yr

Potomac Estuary: 26.9 kg.yr

Any questions about methods for generating loads?

Geographic distribution of loads

1) Which model cells receive highest annual loading?
2) Where do CSO / WWTP / Atmos / Tribs / Contam Sites have maximum impact?

Virginia: Top 10 loading rates

Annual load to a PCB model cell / cell volume.

(ng/year/l)

Virginia: Top 10 loading rates

Cell	Location	Load Rate (ng/year/l)	Cause
185	Occoquan R	3,950	Trib. (99.9%)
207	Cameron R.	120	Trib (73%), WWTP (12%)
199	Accotink Cr.	56	Trib (59%), Dir Drain (32%)
210	Four Mile R.	49	WWTP (70%), Atm (20%)
198	Pohick Cr.	30	WWTP (78%), Atm (21%)
197	Gunston Cove	18	Dir Drain (65%), Atm (35%)
192	Occoquan R	16	Dir Drain (64%), Atm (36%)
171	Aquia Cr.	13	Trib (85%),
204	Little Hunting	11	Atm (73%), Dir Drain (27%)
184	Neabsco	10	WWTP (63%), Atm (36%)

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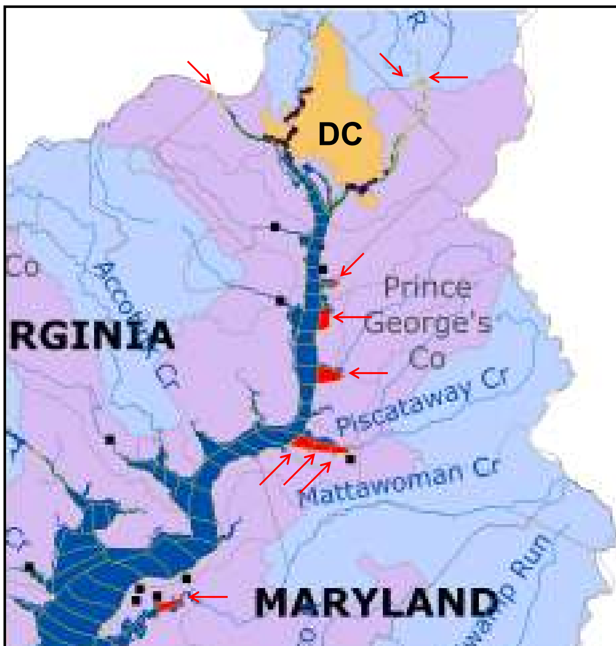

Maryland: Top 10 loading rates

Annual load to a PCB model cell / cell volume.

(ng/year/l)

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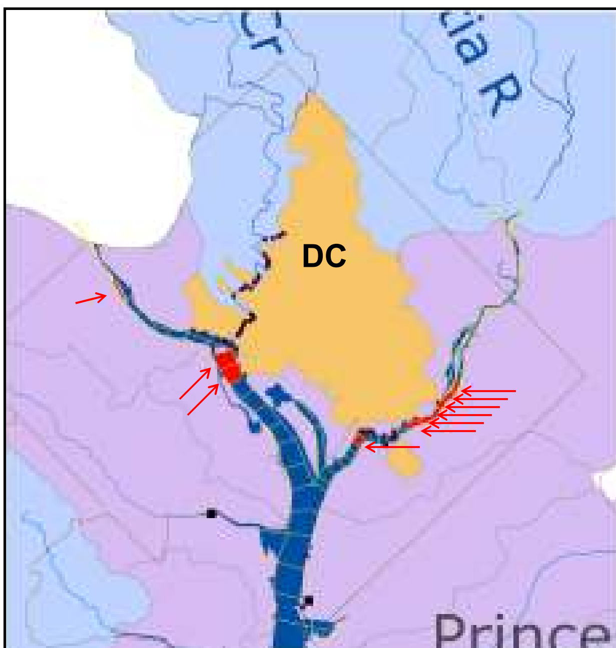
Maryland Top 10 Loading Rates

Cell	Location	Load Rate (ng/year/l)	Cause
97	Pot Chain Br	17,500	Potomac R (100%)
247	NE Anacostia	3,380	Trib (98%)
246	NW Anacostia	1,790	Trib (97%)
203	Piscataway	37	Trib (50%) Atm (20%) WWTP (17%)
209	Oxon Run	26	Dir Drain (63%), Atm (37%)
179	Mattawoman	24	Trib (60%), Dir Drain (22%)
202	Piscataway	24	Dir Drain (69%), Atm (31%)
201	Piscataway	18	Dir Drain (58%), Atm (42%)
206	Potomac R.	13	Atm (75%), Dir Drain (25%)
205	Henson Cr.	11	Atm (79%), Dir Drain (21%)



Dist of Columbia Top 10 loading rates

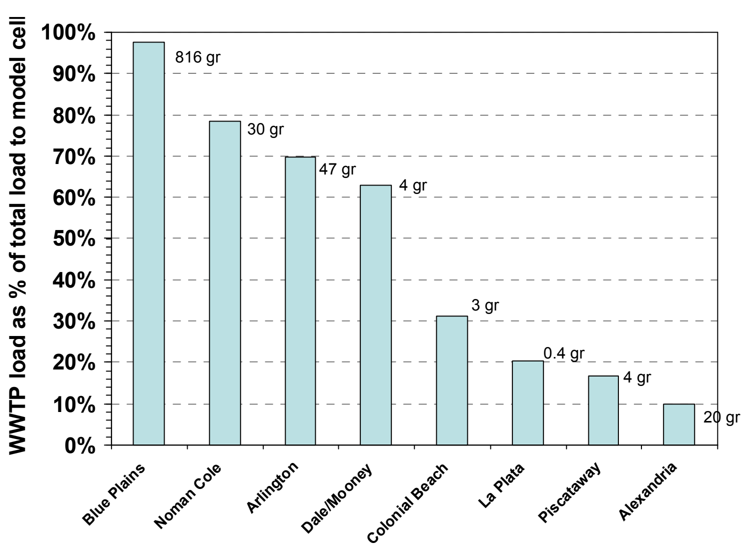
Annual load to a PCB model cell / cell volume.

(ng/year/l)

District of Columbia: Top 10 loading rates

Cell	Location	Load Rate (ng/year/l)	Cause
228	Anacostia	4224	Dir Drain (100%)
226	Anacostia	2855	CSO (96%)
227	Anacostia	1878	Dir Drain (99%)
94	Potomac R	541	Dir Drain (100%)
217	Anacostia	470	CSO (97%)
225	Anacostia	419	Dir Drain (98%)
87	Potomac R	280	Trib (87%)
224	Anacostia	273	Dir Drain (97%)
223	Anacostia	236	Dir Drain (89%)
86	Potomac R	226	CSO (98%)

WWTPs with highest fraction of load to a PCB model cell



Numbers by bars are annual WWTP PCB load in gr/year.

Contaminated sites contributing more than 10% of total load to a receiving model cell.

Site	Dynhyd	PCB (Site) (g/yr site)	PCB gr/yr to dynhyd)	%
Kenilworth-N	233	2.34	3.0	77%
Kenilworth-S	234	0.61	1.4	43%
Dahlgren	22	5.39	26.4	20%

Percent contribution to cells 233, 234 may decrease if direct drainage is adjusted.

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Summary & Issues to Consider

1) Do not yet know fate and transport of PCBs in the estuary.

a) These estimates of external loads do not have any chemical or physical processes to represent PCB fate and transport or exchange with the sediment layer. For these processes, we need the estuarine PCB model.

2) Contaminated Sites

a) These loads are quite small relative to other sources. Is this result consistent with high PCB levels in fish and sediment near Quantico and perhaps other contaminated sites.

b) Despite small loads there still is a potential that some contaminated sites may contribute to a water quality criteria violation.

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Summary & Issues to Consider

3) **Point Sources**:
   a) Blue Plains is almost 90% of point source load and is delivered to a single estuary model cell in DC (lowest WQ standard).
   b) Other WWTPs may contribute a locally important load in some cases. Estuary model will determine if load reductions are required to meet water quality standards.
   c) We do not have sufficient wet weather samples to distinguish wet flow PCB vs dry flow PCB.
4) **Potomac River**:
   a) Most important single source. Getting this estimate correct is critical.
   b) Selection of calibration and TMDL hydrologic years will have large impact on load from this source.
   c) Implications for the TMDL: What can TMDL say about reducing upstream load?

Summary & Issues to Consider

5) **Tributaries and Direct drainage**
   a) Tributaries and direct drainage contribute roughly equivalent loads per unit drainage area (consequence of using WM5 as driver for calculation).
   b) Tributaries & Direct Drains (= non point source, = MS4), are major contributors to selected parts of tidal Potomac
6) **CSO**:
   a) With Potomac River, this source most important for meeting DC WQ standard. CSO load might be as much as 2x Blue Plains load.
   b) Very weak basis for making CSO load estimates..
   c) Are we double counting Alexandria direct drainage and CSO?

Summary & Issues to Consider

7) **Atmospheric deposition**
   a) Contributes more than 50% of load to 204 out of 258 PCB model cells, comprising 97% of estuary surface area.
   b) Justification for deposition rate is "soft", while the potential load may be quite substantial.

Points of contact for the PCB TMDL

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Maryland: Anna Soehl, ASoehl@mde.state.md.us , (410) 537-3509

Virginia: Mark Richards, marichards@deq.virginia.gov , (804)698-4392

EPA: Charles App, app.charles@epa.gov , (215)266-1928

ICPRB: Carlton Haywood, chaywood@icprb.org, 301-984-1908 x105

Additional information about this TMDL can be found at
http://potomacriver.org/water_quality/pcbtmdl.htm